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THE BOGS AND SWAMPS OF WHITE RUSSIA

By C. REGEL, *Formerly of the Botanic Gardens, University of Kaunas*

1. INTRODUCTION

The swamps of White Russia, or the White Russian Socialistic Soviet Republic, are going to be drained, we read in the Russian newspapers. That notice concerns particularly the swamps of the Pripet river country, the Polesje, the largest swamp area in Europe. White Russia is the western part of the Soviet Union, situated to the east of Poland and the former Baltic states, Lithuania and Esthonia. The climate is much more continental in these states, as White Russia is less influenced by the Baltic Sea. The consequence is that the vegetation has a continental character and differs essentially from the vegetation of western Europe and also from the vegetation of the former Baltic states, a conclusion that applies also to the bogs, an essentially climatic type of vegetation. On the other hand, White Russia is one of the countries least influenced by the activity of men, so that there are here very extended and quite untouched swamps.

It is not easy to estimate the area of the peat-lands in White Russia. However, we can follow Weber (1903) in limiting the survey to soils covered with more than 20 cm. of peat. In that case we have to do with different types of damp and wet soils, beginning with the marshes, fens, swamps and bogs without trees, and ending with the forests on peat, the fen woods and the boggy woods.

The other difficulty in the statistics is that until recently the boundaries of White Russia were not fixed. Until the end of 1939 the western part of White Russia belonged to Poland and was divided into administrative districts, the *województwo*, the frontiers of which did not fall together with those of White Russia. The eastern part of White Russia belonged then to the Soviet Russia Union. In 1939 the two parts were reunited and now form the White Russian Socialistic Soviet Republic. But though the actual frontiers do not entirely correspond to the boundaries of the White Russian people and the country of the Polesje belongs partly to the Ukranian Socialistic Soviet Republic, we can combine the Polish and the Soviet statistics. We thus get the following results, which I take from the book of Engelhardt (1943), about White Russia:

The former Polish part of White Russia contains, according to Czarnoski (1943), 900,000 ha. of peat soils, including 70,000 ha. in the *województwo* of Wilno, 300,000 ha. round Białystok, 470,000 ha. around Polesje and 6000 ha. near Nowogródek. The average thickness of the peat is from 1 to 1.5 m., so the total quantity of air-dried peat will be, according to the Polish estimate (see Engelhardt, 1943), 11.25 million tons.

In the eastern part of White Russia, i.e. within the pre-1939 frontiers of the White Russian Soviet Republic, the area of peat is 1,500,000 ha. The average thickness of the peat being 2 m., this will yield from 250,000,000 to 900,000,000 tons of air-dry peat (Engelhardt, *loc. cit.*). The total area of peat soils in the White Russian Soviet Republic (within the frontiers of 1940) is 2,400,000 ha., and the quantity of air-dry peat will be from 1000 to 2000 million tons.

The map in Engelhardt's book shows the distribution of the peat in White Russia which coincides approximately with the distribution of the swamps. The distribution of peat given for the western part of White Russia, which formerly belonged to Poland, corresponds nearly to the actual state, but in the eastern part of White Russia there are many more swamps, e.g. those to the south of the town of Slutsk. There are numerous swamps in the Polesje district on the eastern side of the former Polish-Soviet frontier, though the number of swamps is less there than on the western side of this frontier. There are also large swamps south of the town of Mozyr. But Bürgener (1939) says that the percentage of peat soils alone in the ancient wojewódstwo of Polesje is about 40–50 % of the total area of that district.

2. STRUCTURE OF THE PEATS

No comprehensive survey exists of the structure of the peats of White Russia, but we have some investigations concerning the country of the Polesje. There are first the works of Kulczynski (1930, 1933) on the whole (formerly Polish) Polesje and the papers of Dąbkowska (1932) on the river basin of the Lan. According to Kulczynski we can distinguish by the method of pollen analysis two very distinct horizons, as follows:

(i) The upper horizon contains a rich flora of mixed woods, consisting of *Pinus sylvestris*, *Alnus*, *Picea excelsa*, *Quercus*, *Tilia*, *Corylus avellana* and *Fagus*, and here and there of *Abies*, *Carpinus* and *Ulmus*.

(ii) The lower horizon is characterized by a very poor woodland flora, which contains only *Pinus sylvestris*, *Betula*, and *Salix*. *Tilia*, *Fagus*, *Abies*, *Carpinus* and *Ulmus* are absent, and the pollen of *Alnus*, *Picea*, *Corylus* and *Quercus* occurs only in very small amounts.

The upper rich flora of mixed forest woods corresponds undoubtedly to a warmer climatic period, which is equivalent, according to Kulczynski, to the Litorina-subatlantic period. The *Pinus-Betula* horizon, poor in species, corresponds to a colder climatic period which is regarded by the same author as of the Ancylus-Yoldia time. There are many peats and marine sediments in the Polesje which belong to an alluvial epoch. Older profiles are rare. An analysis of their layers shows that they belong to the interglacial epoch and, according to Kulczynski, to two different interglacial periods: the interglacial period Würm II-Baltic glacial period and the interglacial period Würm I-Würm II.

Fagus sylvatica, the beech, is now entirely absent from White Russia, but pollen occurs in the swamp-peat of the Polesje, from which we can conclude that the whole country of the former Polish Polesje was, in the Litorina period, within the area of the beech. A similar case, too, is that of the silver fir (*Abies alba*) which does not occur in the Polesje, though the pollen is found in small quantities in the zone of mixed woods.

The oldest profiles of peat dating from the interglacial period are rare. More frequent are swamps and bogs on peat which can be traced up to the Ancylus-Yoldia time, that is, they have a solidly formed *Pinus-Betula* horizon. Abundant are the very young swamps, which reach only to the Litorina time and showing, therefore, only a horizon of mixed woods, rich in species. The oldest layers may consist of lake gyttja, more rarely occurring in the Ancylus-Yoldia zone marshes. Raised bogs are young everywhere, occurring on the more recent peats.

The oldest peats, dating from the interglacial and the old alluvial time, are situated on the watersheds and on the right-bank terraces of the basin of the Pripiet river.

3. THE VEGETATION OF THE SWAMPS

There exists no comprehensive survey of the vegetation of these peat-covered areas of White Russia, but only partial studies. I have not seen the short survey made by Tjuresmow (1931) on the bogs of western White Russia. Under the Soviet parts of east White Russia have been investigated, but most of the reports have not been published.

As the most extended swamp areas are in the southern part, in the country of the Polesje called the Pripet or Rokitno marshes, the majority of the investigations have been made in this area.

The first papers are by Tanfiljew (1895, 1899), who investigated the country of the Polesje under the direction of the Expedition of General Shilinski (see further). In 1913 appeared my paper on the swamp of the northern part of the Polesje, and at the same time Dokturowski started his investigation on the swamps of the Polesje (see Dokturowski, 1913; Dokturowski & Shukow, 1917; Tscherny & Dokturowski, 1915). But all these investigations were interrupted by the first war. During this Tessendorf (1921), a member of the German army, studied the country of the Schtschारा river in the western part of White Russia. We possess some papers about the western part of the Polesje, which after the peace of Riga in 1922 belonged to Poland, as the Polish Government founded in the town of Brest a station for the study of the swamps (Bureau for Draining the Polesje). (Consult, for example, the papers of Pruchnik (1933*a, b*), Kulczynski (1930, 1933), Szafran (1930), Tolpa (1932*a, b*, 1935) and others.) There is, as I mentioned, no survey of the swamps of White Russia including the country of the Polesje and the northern part of White Russia, the latter being quite unknown. Katz (1928) gives only a short account of the oligotrophic moors.

We distinguish usually low moors and high moors, but as Tansley (1939) avoids using these terms, we will use his nomenclature. First there are raised bogs, which prevail in the northern part of White Russia and are less frequent in the country of the Polesje. There marshes and swamps are more common. Their predominance in the Polesje is not accidental. We can explain it by the fact that this country is a low one with many rivers, which have only a very small fall and therefore the whole country is flooded in spring by the water of the rivers. Nevertheless, there occur, in the district of the town of Mozyr on the Pripet, extended raised bogs with *Sphagnum*. These and other traces of raised bogs occur on the not flooded margins of the swamps. The raised bogs of the northern part of White Russia are more or less continuous with those of northern Russia and the former Baltic states. The raised bogs of the southern part of White Russia have a much poorer vegetation, because they are situated near the southern limit of their distribution in eastern Europe (see Poljanska, 1931), where they occur on the watersheds, while the swamps and marshes mainly occur in the valleys of the rivers and occasionally on the watersheds. According to Dokturowski (1927), the southern limit of the distribution of the *Sphagnum* bogs passes through the middle part of the former Russian Government of Minsk, i.e. the country of the Polesje.

The contrast between the swamps of the northern and the southern parts of White Russia or the Polesje is noted also in the paper of Katz (1936), according to whom the northern part of White Russia belongs to the eutrophic and oligotrophic *Pine-Sphagnum* bogs of the Moscow district and the upper reaches of the Dnieper. The southern part of White Russia, the Polesje, inside, belongs to 'the eutrophic and oligotrophic *Pinus*, *Eriophorum*, *Sphagnum* bogs of the country of the middle reaches of the Dnieper'. Both

groups of swamps occur in the southern part of the zone of the coniferous woods. Katz also says that the coniferous woods in the western part of his 'moor' country, i.e. the bogs and swamps of northern White Russia, are practically unexplored.

The oligotrophic bogs, or, otherwise, the raised bogs, which cover here a great area, belong to the type of bogs with *Pine-dwarf shrubs-Eriophorum* and *Sphagnum*, that is, they are overgrown with pines and dwarf shrubs, as *Ledum palustre*, *Vaccinium uliginosum*, *Andromeda polifolia*, *Chamaedaphne calyculata* and herbaceous plants; small *Carices*, *Rubus chamaemorus*, *Eriophorum vaginatum* and others. The quantity of *Chamaedaphne calyculata* seems to decrease to the west and to increase to the east and north-east. These bogs belong to the type of Oswald's (1925) continental bog. The swamps and marshes of this area ('eutrophic moors') are essentially similar to those of the Polesje.

In the Polesje, the southern swamp country, according to Katz, the number of bogs decreases. This author states also that the absence of *Chamaedaphne calyculata* on the raised bogs is characteristic, though bogs with *Pinus*, *Eriophorum vaginatum* and *Sphagnum* occur very frequently. Northern species, e.g. *Rubus chamaemorus*, *Empetrum nigrum* and *Betula nana*, do not occur, and the most common dwarf is *Ledum palustre* (Katz, 1928), which takes the place of *Chamaedaphne calyculata*.

Also of interest are 'relict' species, e.g. the *Rhododendron flavum* (*Azalea pontica*) which grows occasionally near lake Knjaz (Stecki & Jakubczyk, 1932; Poljanska, 1925). In the water we find some relicts as *Salvinia natans*, *Aldrovanda vesiculosa* and *Trapa natans*.

Katz (1928, 1930) mentions on the *Sphagnum* bogs *S. angustifolium* and *S. medium*. Sometimes the western species *Sphagnum rubellum* occurs.

Much more widespread in the Polesje are the marshes, particularly near the town of Pinsk. *Glyceria maxima* and *G. fluitans*, *Phragmites communis*, *Phalaris arundinacea*, *Typha angustifolia* and *T. latifolia*, big *Carices*, as *C. vesicaria*, *C. acuta*, *C. inflata*, *Equisetum fluviatile* and *Scirpus lacustris*, play an important part. There is little peat, but instead deposits of gyttja. Other characteristic plants of the marshes are *Iris pseudacorus*, *Alisma plantago aquatica*, *Sagittaria sagittifolia*, *Butomus umbellatus*, *Cicuta virosa*, *Oenanthe aquatica*, *Sium latifolium*, *Eupatorium cannabinum*, *Lysimachia vulgaris*, *Lythrum salicaria*, *Ranunculus lingua* and *Rumex hydrolapathum*.

We can distinguish several associations of the marshes, e.g.

- (1) The *Acoretum calami*.
- (2) The *Phragmitetum communis*.
- (3) The *Glycerietum maximae*.
- (4) The *Scirpetum lacustris*.

The soil of the marshes is always waterlogged. In summer the water-level is high and above the soil surface.

Particularly frequent in the Polesje are the alderwoods, extending for many kilometres along the banks of the rivers. They enclose many plants, such as *Iris pseudacorus*, *Phragmites communis*, *Eupatorium cannabinum*, *Phalaris arundinacea*, *Caltha palustris*, *Oenanthe aquatica*, *Equisetum fluviatile*, *Filipendula ulmaria* and *Lythrum salicaria*.

We can distinguish other types of treeless swamp with *Carices* and a thick sheet of *Drepanocladus* moss, which occur only in places, where water of the river does not rise during the spring. Some small shrubs are found such as *Betula humilis* and the willows *Salix repens* var. *rosmarinifolia* and *S. lapponum*. Other characteristic plants of these swamps are the following (see Regel, 1941): *Dryopteris thelypteris*, *Equisetum fluviatile*,

Phragmites communis, *Agrostis canina*, *Calamagrostis neglecta* and *C. lanceolata*, *Eriophorum angustifolium*, *Carex diandra*, *C. chordorrhiza*, *C. reticulosa*, *Stellaria palustris*, *Caltha palustris*, *Comarum palustre*, *Peucedanum palustre*, *Lysimachia thyrsiflora*, *Menyanthes trifoliata* and *Galium uliginosum*.

Some of the swamps are very extended, that known as the Gritschin is 50 km. long and 20 km. wide.

I have distinguished in my paper five associations of these swamps, as follows:

- (1) The *Calamagrostidetum neglectae*-*Cariceto*-*Drepanocladetum*.
- (2) The *Caricetum chordorrhizae*.
- (3) The *Calamagrostidetum lanceolatae*.
- (4) The *Caricetum reticulosae*.
- (5) The *Caricetum vesicariae*-*Glycerietum fluitantis*.

Dokturowski & Shukow distinguish in their study on the swamps of the river Ptitsch eleven types as follows:

- (1) *Swamps with Carices and Hypnaceae*:
 - (a) The *Cariceto-Acrocladietum* with *Carex acuta*, *C. vesicaria*, *C. inflata* and a thick layer of *Acrocladium cuspidatum*.
 - (b) The *Cariceto-Calamagrostideto-Acrocladietum* with much *Calamagrostis neglecta* and *Calamagrostis lanceolata* and several *Carices*.
- (2) *Swamps with Carices-Phragmites-Hypnaceae*:
 - (c) The *Cariceto-Phragmiteto-Acrocladietum*.
 - (d) The *Cariceto-Phragmiteto-Drepanocladetum*.
- (3) *Swamps with Carices-Hypnaceae and Equisetum, Galium, etc.*
 - (e) The *Equiseto-Cariceto-Galieto-Acrocladietum*.
 - (f) The *Cariceto-Galieto-Acrocladietum*.
 - (g) The *Cariceto-Galieto-Acrocladietum* with *Carex chordorrhiza*.
- (4) *Swamps with Carices-Sphagnum-Hypnaceae*:
 - (h) The *Cariceto-Sphagneto-Acrocladietum* with *Carex limosa*.
 - (i) The *Cariceto-Sphagneto-Drepanocladetum*.
- (5) *Swamps with Agrostis-Carices-Sphagnum and Hypnaceae*:
 - (j) The *Agrostideto-Cariceto-Acrocladieto-Sphagnetum*.
- (6) *Swamp with Carices-Phragmites-Sphagnum*:
 - (k) The *Cariceto-Phragmitetum-Sphagnetum*.

Other swamps are covered with trees, as *Betula pubescens*, with *Carex paradoxa* and other *Carices* forming tussocks. Here occur also *Dryopteris thelypteris*. Felling the birches and mowing the grass for hay causes many of these swamps to turn into swamps without trees. During the first war such swamps became overgrown with small willows and *Betula humilis*. Finally *B. pubescens* appeared, because the grass had not been mowed. The hay produced on these swamps is very bad, because they consist mainly of *Carices*, while the crop per acre is very small.

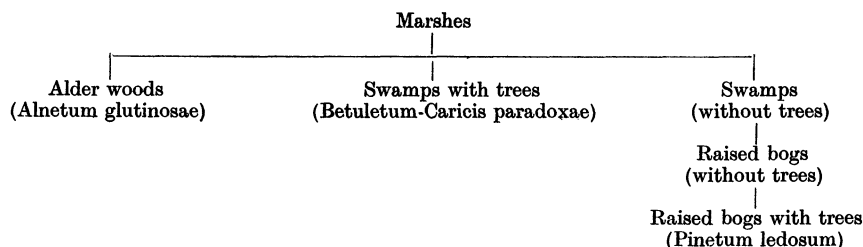
The moss layer on the swamps is formed by *Drepanocladus* species, e.g. *D. vernicosus* and *D. aduncus* (see Regel, 1941); there occurs also *Aulacomnium palustre* and some *Sphagnum*, e.g. *S. contortum*, *S. obtusum* and sometimes *S. Jensenii*.

The peat of the swamps is acid. Its thickness is sometimes very considerable and reaches several metres. The swamps have usually risen from marshes, and their

further succession will end in a raised bog or in a swampy wood. The peat is always very wet.

As the peat is of acid reaction, the vegetation of the swamps is rather poorer than the vegetation of the English fens, as mentioned by Tansley. Fen-like vegetation of a type corresponding to the English fens we find only as a transition succeeding reed-swamps. There are, however, artificial fens, about which we will speak later, and the alderwoods mentioned above, which also belong to the fen type of woodland.

The succession of these communities has not been thoroughly studied, but the main sequences are embodied below:



4. THE UTILIZATION OF THE SWAMPS AND BOGS

There are two kinds of swamp exploitation: the extraction of peat and its amelioration for agriculture after being drained. Before the war of 1914–18 the extraction of peat did not play a noteworthy part, though the amount of peat is a very considerable one and constitutes, as mentioned above, from 1000 to 2000 million tons. After this war the extraction of peat mainly increased in the eastern part of White Russia. According to the pocket calendar for the year 1935 (*Nastolnyj-Kalendar*, 1935) the extraction of peat amounted to 2,000,000 tons a year, while before the war it amounted to only 14,000 tons. The peat for industrial purposes is the peat of the raised bogs, and as a consequence industrial utilization of peat is much more frequent in the northern part of White Russia than in the country of the Polesje. The swamps and marshes of the latter barely rise above the level of the rivers, and are more suitable for agricultural purposes.

The draining of the swamps was started by the Western Expedition under the leadership of General Shilinski. This expedition worked from 1873 to 1898 in the whole western part of Russia, but particularly in the country of the Polesje. The work is described in a book which appeared in 1899 (Shilinski, 1899). As an appendix to this book appeared a description of the swamps by Tanfiljew (1899). The main results of the expedition are a survey of the whole country of the Polesje, a scientific investigation, and the draining by many open ditches and canals with a total length of about 4800 km. The so-called 'general plan', indeed, foresaw a vaster programme, which was not accomplished, because the work of the Expedition came to an end in 1898, when only about 3,200,000 ha. had been drained instead of the 8 million ha. included in the plan.

The drainage operations initiated by General Shilinski have been continued by private efforts. Methods of improvement by irrigation were first used by Mr W. Regel on his estate of Kopaczewitchi in the northern part of the country of the Polesje (Regel, 1913, 1941). The principle employed was to irrigate the drained area with river water, by a system of channels and sluices, so that the mineral matters necessary for the growth of good grasses are deposited on the acid peat.

The influence of this irrigation on the vegetation of the drained swamps was investigated by Dokturowski (1913) and myself (Regel, 1913, 1941). *Carices*, which first dominated the swamps, give place to grasses, of which *Poa pratensis* dominates, and the amount of hay on these drained swamps is greatly increased. In Kopaczewitchi the amount of hay before the treatment was about 120,000 cwt., while afterwards it rose to 3,000,000 cwt.

The most characteristic plants of these drained and irrigated swamps are the following: *Equisetum fluviatile*, *Dryopteris thelypteris*, *Festuca rubra*, *Poa pratensis*, *Agrostis alba*, *Calamagrostis elata*, *C. neglecta*, *Carex diandra*, *Eriophorum angustifolium*, *Carex paradoxa*, *Rumex acetosa*, *Lychnis flos-cuculi*, *Caltha palustris*, *Stellaria palustris*, *Comarum palustre* and *Galium uliginosum*.

Mosses occur in very small quantities on the irrigated swamps, as they are destroyed by river water. Regel in his papers places the irrigated swamps of Kopaczewitchi in the following communities:

- (1) The *Poetum pratensis*.
- (2) The *Calamagrostidetum neglectae*.
- (3) The *Poetum pratensis-Calamagrostidetum neglectae*.
- (4) The *Calamagrostidetum elatae*.
- (5) The *Agrostidetum stoloniferae-Calamagrostidetum neglectae*.
- (6) The *Poetum pratensis-Festucetum rubrae*.

On the *Poetum pratensis* the quantity of *Poa pratensis* was 47% of the total weight of the sample of hay. On the *Calamagrostidetum neglectae* the quantity of *Calamagrostis neglecta* was 73%, the quantity of *Agrostis alba* was 33% and of *Festuca rubra* 29%, of *Eriophorum angustifolium* 29.8% and of *Carex reticulosa* 24.7%.

Some species of the undrained swamps survive, but their quantity is not very considerable. Mostly these are plants occurring on fens also, so we can deduce that the influence of irrigation consists in transforming a swamp into a fen. We will speak then of artificial fens. Under the influence of river water, which contains mineral particles and much oxygen, the peat of the swamp becomes less acid and more adapted to the growth of grasses, as, for example, *Poa pratensis* and *Agrostis alba*.

The improvement of swamps by means of irrigation has been widely introduced. In the year 1910 a research station was founded in Minsk, the scope of which was to work on swamp improvement in western Russia and particularly in the country of the Polesje. The *Journal* of this station (see *Trudy*, 1925) contains many reports (e.g. Mlinaritsch (1914); Gansha (1913)), dealing with the advantages and disadvantages of the method of irrigation.

Since the war of 1914–18 swamp improvement in White Russia has increased considerably. In Poland a vast improvement plan was drawn up and submitted to a special commission of the League of Nations (*Note*, 1927). Though in 1928, a Bureau was created in Brest, the Government of Poland had insufficient means to accomplish much. Details of improvements in White Russia are given by Kostjakow (1933).

5. CONCLUSIONS

It is clear that in time the original marshes, swamps, bogs and extended alderwoods will disappear and give place to cornfields, meadows and pastures. Suitable crops are vegetables, the gum plants (*Taraxacum kok-saghyz*) and hemp. The Polesje soils can give big crops on being drained and manured by nitrogenous, potassium and phosphorus manures,

as is seen from the experiments of the Research Station in Sarny (Pruchnik, 1933). According to Suworow (1932) the eastern part of White Russia belongs to the milk-hemp district of White Russia, where perhaps we may discern the main exploitation of the country in the future.

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